Lessons Learned From Implementing RI-IST Programs

Technical Report

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Final Report, June 2000

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REPORT SUMMARY

Integrated, risk-informed, and performance-based active component reliability programs can enhance the operating economics of nuclear power plants while maintaining or improving safety. This report presents an analysis of the costs and benefits of converting from an inservice testing (IST) program to a risk-informed inservice testing program (RI-IST) based on NRC and industry pilot/demonstration programs over the last few years.

Background

An important issue for building and operating a nuclear power plant has always been generating electricity safely and economically. The safety of plants is achieved through many programs, including an inservice inspection and testing program, mandated by the NRC according to ASME requirements. If inservice testing could be modified for Low Safety Significant Component (LSSC) pumps and valves, plant economics and safety can be improved. To accomplish this goal, EPRI published a number of reports and templates on a technical/licensing approach to Risk-Informed Inservice Testing of components such as pumps and valves. This work was undertaken in conjunction with several ASME projects including OMN-3 Code Case against the ASME OM Code that provided the methodology/process. The NRC endorsed the methodology/process with Regulatory Guide 1.175 a few years ago. With 23 pilot and demonstration plants in RI-IST over the last several years, it has been shown that about 50% of the IST pumps and 80% of the IST valves are LSSC.

Objective

To analyze the costs and benefits of converting an IST program to a RI-IST program.

Approach

The project team analyzed recent industry experience in order to define the costs and benefits of implementing RI-IST.

Results

With modified testing strategies for LSSC pumps and valves, plant economics can be improved with less surveillance tests, the removal of surveillance tests from the refueling outage critical path, the avoidance of person-rem exposure, and synergistically linking IST and other various component reliability programs. The first pilot plant to get NRC approval for a RI-IST program, Comanche Peak, plans to reduce the number of surveillance tests per refueling cycle from 1758 to 498—a 72% reduction. At the second plant to get NRC approval for a RI-IST program, San Onofre, the number of IST surveillance procedures performed during the refueling cycle is being reduced from 8524 to 4516. This reduced number of procedures is expected to save 10,000

person-hours per year or $50,000 per refueling cycle, including 36 hours of critical path surveillance testing during the refueling outage.

One reason why there are only two plants with NRC approved RI-IST programs is that most plants are still working on avoiding forced outages and reducing refueling outage length. Clearly a base-loaded plant generating electricity 85% to 95% of the time is the primary goal of plant management. When that goal is achieved, efficiently integrating plant “programs” is the effective way to achieve staff reduction, a major factor in reducing operating costs. Future NRC risk initiatives may make the RI-IST option yet more attractive by substantially reducing the costs for implementing surveillance procedures for LSSCs.

EPRI Perspective

An integrated, risk-informed, and performance-based active component reliability program is the way to achieve further operating economics while maintaining safety. Since IST is a Tech Specs mandated program for nuclear safety defense-in-depth and safety margin, converting this program to RI-IST while integrating with the other plant component reliability programs is a great way to achieve further improvement in plant operating costs.

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Keywords

Inservice testing
Risk-informed inservice testing
Maintenance
Pumps and valves
Nuclear power plants
O&M

ABSTRACT

With modified testing strategies for the LSSC pumps and valves, plant economics can be improved with less surveillance tests, the removal of surveillance tests from the refueling outage critical path, the avoidance of person-rem exposure, and synergistically linking IST and other various component reliability programs.

While RI-IST programs generally produce more efficient and effective testing of IST components, a plant considering implementing such a program, must also consider the cost and benefits that are likely when converting from an IST program to a RI-IST program. This report presents an analysis of such costs and benefits based on NRC and industry pilot/demonstration programs over the past few years.

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1
INTRODUCTION

Overview

EPRI performed a series of projects in the mid 1990s, published a number of reports and templates on a technical/licensing approach to Risk-Informed Inservice Testing of components such as pumps and valves. This work was in conjunction with several ASME projects (including OMN-3 Code Case against the ASME OM Code that provided the methodology/process). The NRC endorsed the methodology/process with Regulatory Guide 1.175 a few years ago. With 23 pilot and demonstration plants in RI-IST over the last several years, it has been shown that about 50% of the IST pumps and 80% of the IST valves are LSSC.

An important issue for building and operating a nuclear power plant has always been generating electricity safely and economically. The safety of plants is achieved through many programs, including an inservice inspection and testing program, mandated by the NRC according to ASME requirements.

To make an operating nuclear power plant more economical, forced outages must be avoided, short refueling outages must be the norm, and plant “safety programs” must be synergistically integrated. Each operating plant has numerous “programs” to operate and maintain the plant. Thus synergistically coupling pump and valve IST with these additional component reliability programs is clearly desirable. What are the obstacles to the achievement of this synergy? First obstacle is that the requirements for various component reliability programs have both safety and economics as the driver. Second obstacle is that frequently different plant organizations are responsible for these various component reliability programs. Third obstacle is that the responsible personnel for these two component reliability programs that need to be coordinated quite frequently have substantially different levels of expertise and available time to take on the pro-active effort to capture this synergy.

There has been an ongoing industry effort to use performance to achieve this desired synergy. More recently there has been an effort at both NRC and within the industry to apply risk to both improve safety and improve operating economics. This effort has culminated in a long-term initiative to revise 10 CFR 50, to make it more compatible with risk insights that can be developed with current risk technology. The intent is to focus safety resources on those areas most important to the physical safety of the plant and public.

Ideally plant component (specifically pumps and valves) reliability programs would achieve synergy via both risk and performance. Industry has learned that good safety practices and good economic practices are synergistic with each other. So far, two plants have received NRC approval for their RI-IST programs. One reason why there are only two plants with such approval is that most plants are still working on avoiding forced outages and reducing refueling outage length. Integrated, risk-informed, and performance-based active component reliability programs are the way to achieve further operating economics while maintaining safety.

The first pilot plant to get NRC approval for a RI-IST program, Comanche Peak, plans to reduce the number of surveillance tests per refueling cycle from 1758 to 498…a 72% reduction. The second plant to get NRC approval for a RI-IST program, San Onofre, the number of IST surveillance procedures performed during the refueling cycle is being reduced from 8524 to 4516. Also for San Onofre, due to less IST implementing SPs, they expect to save 10,000 person-hours per year or $50,000 per refueling cycle, including 36 hours of critical path surveillance testing during the refueling outage.

Nomenclature

AFW	Auxiliary Feed Water
AOV	Air Operated Valve
ASME	American Society of Mechanical Engineers
CIV	Containment Isolation Valves
CFR	Code of Federal Regulations
CRTD	Center for Research & Technology Development
CV	Check Valve
EPRI	Electric Power Research Institute
HSSC	High Safety Significant Component
INPO	Institute of Nuclear Power Operations
IST	Inservice Testing
JOG	Joint Owner Group
LSSC	Low Safety Significant Component
MOV	Motor Operated Valve
NRC	Nuclear Regulatory Commission
O&M	Operations & Maintenance
PIV	Pressure Isolation Valve
PRA	Probabilistic Risk Assessment
RAI	Requests for Additional Information
RCM	Reliability Centered Maintenance
RI-IST	Risk-Informed Inservice Testing
SECY	Secretary of Commissioners (NRC)
SER	Safety Evaluation Report
SIT	Safety Injection Tank
SOER	Significant Operating Event Report
SP	Surveillance Procedure

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ECONOMIC PERSPECTIVE

The case for building and operating a nuclear power plant has always been the economics of generating electricity. The increase in nuclear power plant operating costs over the years, due in part to increased regulatory requirements, has made some plants uneconomical. Some of the increase in O&M costs was due to layering of added plant “programs” to address regulatory issues. Uneconomical plants have a choice: reduce operating costs or shutdown. The recent trend in the U.S. to deregulate electrical generation has forced the economic issue to the forefront of management attention.

What can an operating nuclear power plant do to make itself more economical? The number one initiative is to operate the plant safely so that long-term outages to improve safety are not necessary. The number two initiative is to prevent forced outages, so that the plant operates continuously from refueling outage to refueling outage. Fortunately, there are numerous plants within the nuclear industry that have accomplished this goal. The number three initiative is to shorten those refueling outages from the ninety-odd days that were average in 1990 to twenty or thirty days (or even shorter). For example, South Texas Electric Generating Station has had several refueling outages in the twenty-day timeframe. There are many plants now getting into the thirty-day timeframe. Most plants have been working on these initiatives for several years, because the impact on operating economics is huge.

So when the safely operated plant has a rolling availability of 85 to 95%, then it has to look for the number four initiative, which is to make its various “programs” more efficient. When the “programs” become more efficient, the operating staff can be reduced, which is where substantial operating economics can be achieved. This also acts to improve safety — since risk insights can be used to improve operational strategies. For example, risk-informed technical specifications are more likely to provide a safe operating envelope than the traditional approach. However if the operating staff is reduced before the “programs” are made more efficient, then the possibility of operating the plant is an unsafe manner becomes far more likely.

Of course the number five initiative is to find more available megawatts within the plant via design changes, more accurate instrument calibration, different safety analysis, etc. For many plants this has already been done, but for those operating plants with the “alligator fighting” approach, this may be yet another management initiative to achieve better operating economics.

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PROGRAMS FOR THE OPERATING NUCLEAR PLANT

Each operating plant has numerous reliability "programs" to operate and maintain the plant. Some programs are driven by operating economics, while others are driven by nuclear safety. The pump and valve IST program is just one of the nuclear safety programs, but as a key aspect of nuclear plant defense-in-depth and safety margin, it is mandated by the plant's Technical Specifications. Over the years other pump and valve component reliability programs have crept into the plant for various reasons. These additional component programs are frequently not coupled to pump and valve IST. Thus synergistically coupling pump and valve IST with these additional component programs is clearly desirable, since this addresses the number four initiative described above. What are the obstacles to the achievement of this synergy?

First obstacle is that the requirements for various programs have both safety and economics as the driver. There are also multiple safety driven component reliability programs. Some good examples are IST versus NRC GL 89-10 for MOVs and IST versus INPO SOER 86-04 for CVs. Sometimes the economic driven programs are not complementary with the safety driven program. A good example of this is IST versus predictive maintenance for pumps.

Second obstacle is that frequently different plant organizations are responsible for these various component programs. Synergistically coordinating programs across departments is far harder to accomplish than within the same department. This is because departments inherently tend to over-optimize their assigned goals and objectives at the expense of other departments.

Third obstacle is that the responsible personnel for the two programs that need to be coordinated quite frequently have substantially different levels of expertise and available time to take on the pro-active effort to capture this synergy. All too often one of the responsible personnel is relatively new to the position and is learning to handle day to day tasks, thus having no time to long range improvement efforts.

Current Cost of IST Programs

A 1993 EPRI study of IST programs at eight nuclear power plants in the New England area showed that, on average, pump IST took over 800 person-hours per year and valve IST took over 9000 person-hours per year. The average scope of the IST program at these eight plants consisted of 30 pumps and 500 valves. Thus the average annual manpower cost is 26 person-hours for each pump and 18 person-hours for each valve in the IST program. At an assumed wage rate of $50 per hour, on an activity based accounting method, IST programs consume on the order of $500,000 per year.

Table 3-1 for a recent comparison of some typical IST programs provides a feel of the variance in these programs from plant to plant.

Table 3-1
Comparison of Some Plant IST Programs

Plant	# IST pumps	# IST valves	# quarterly SPs	# semi-annual SPs	# cold shutdown SPs	# refueling SPs	# every two years
Comanche Peak 1	33	619	33 + 293		134	40	
South Texas 1	36	725	30 + 525	6	100	145	
Wolf Creek	23	555	23 + 300		61	33	
Callaway	25	538	19 + 46			53	
Indian Point 2	34	717					
San Onofre 2	28	540					
ANO-2	19	337	19 + 233		115	446	
Calvert Cliffs 1	18	425	9 + 16		10 + 10	10 + 10	
Davis-Besse	20	442	42		32	8	
ANO-1	14	324					
Peach Bottom 2	22	448					
Vermont Yankee	26	1300					
WNP-2	16	512	38		11	21	30
Pilgrim	24	1286					
Nine Mile Point 2	26	1680					
Monticello	21	1093					
Limerick 2	39	1623					

Synergy in IST Programs

Over the past ten to fifteen years there has been a somewhat common industry effort to use performance to achieve synergy between plant programs, including IST. Good examples of this are the NPRDS and EPIX equipment databases. In addition there has been a proliferation of user groups, such as NIC, MUG, and AUG. Finally in the mid-1990s, the NRC issued a new rule (10 CFR 50.65) to increase the incentive for improved maintenance performance. Clearly this effort on performance has created high component reliability, but multiple “program” synergy has been elusive and thus staffing improvements have been minimal.

Over the past five years there has been a large effort to apply risk to both improve safety and improve operating economics. This has been possible because every U.S. operating nuclear power plant has a PRA, due to the response to NRC GL 88-20. EPRI, NSSS owners-group, NRC, and ASME have all worked together to apply risk to various “programs,” including IST. This tool actually promotes synergy between “programs” because risk can be used for both safety improvement (through a probabilistic risk assessment) and economic improvement (through an economic risk assessment using the same tool). To date the PRA tool has mostly been used to address safety risk, since assessing plant vulnerability to severe accidents was the goal of GL 88-20. For example the NRC has issued RG 1.174 to address risk-informed regulatory programs in general and a series of four program specific RGs for IST, ISI, GQA, and Tech Specs. However several plants are using the same PRA methodology to evaluate economic risk developing tool such as “trip meters.”

Integration of Component Programs

Ideally plant component (specifically pumps and valves) reliability programs would achieve synergy via both risk and performance. Of course the original plant design placed a lot of pumps and valves in various plant locations to achieve certain system functions. Failure of some of these pumps and valves has an immediate impact on safety or on the generation of electricity. Other pumps and valves have a much more delayed effect on the plant. For example a large leaky CIV may only have an impact when the containment needs to be isolated. Since nuclear power plants have lots of standby systems for nuclear safety, hidden failures are of big concern. Thus IST is a major aspect of defense-in-depth to find and fix these hidden failures.

The PRA identifies in an integrated fashion those SSC that are most important to the plant via these functional systems. Please recall that a simplified definition of risk is:

Risk = Probability of Failure x Consequences of the Failure

Therefore, system risk tends to be driven by the risk of the active components, such as certain pumps and valves, which typically have probability of failure in the order of 1E-03 to 1E-04. Passive components such as tanks and pipe typically have a probability of failure several orders of magnitude lower than the active components. So, to improve plant performance, ergo system performance, those active components must be more reliable…ideally all of those active components.

However, in the real world where resources are not infinite, we can use risk to focus resources on the active components that impact safety (by using the PRA) and generation of electricity (with simplified risk models). A good example is AOVs in most plants. There typically is close to 1000 AOVs in the plant, but perhaps 20 have a high safety risk and 50 have a high economic risk. The ideal goal of a preventive maintenance program might be to make all 1000 AOVs reliable (i.e., replace the elastomers periodically), but practically the goal is to avoid inservice failures for those 20 high safety risk AOVs and those 50 high economic risk AOVs. To avoid that inservice failure, perhaps periodic diagnostics of those 70 AOVs is warranted to monitor degradation in addition to periodically replacing the elastomers.

Risk Categorization of IST Components

The methodology for RI-IST was developed by EPRI in the early 1990s. Other organizations, such as the ASME, were also active in improving the IST programs. For example, the detailed requirements for a RI-IST program are in the ASME OMN-3 Code Case. The applicable NRC Regulatory Guides support this methodology, although they do not yet specifically endorse it. Thus, the RI-IST methodology has been applied in numerous pilot projects and demonstration projects.

Based on the 1995 EPRI study of ten plants in a pilot project, about 50% of the pumps and 20% of the valves in the typical IST program were found to be HSSCs. The other half of the pumps and 80% of the valves were found to be LSSCs. Thus on an average, about 15 of the pumps and 400 of the valves in the IST program are LSSC candidates for an alternative testing method and/or testing frequency. The pilot project, which encompassed a wide variety of plants (age, vendor type, number of units, etc.) and PRAs (size of fault trees and event trees, data assumptions and initiating event assumptions, etc.), showed very consistent PRA risk ranking and expert panel safety categorizations across the ten plants involved.

More recent pilot and demonstration projects for RI-IST validate these HSSC/LSSC pump and valve fractions (see Table 3-2 below).

Table 3-2
Comparison of Full-Scope RI-IST Programs

Plant	HSSC Pumps	HSSC Valves	LSSC Pumps	LSSC Valves
Comanche Peak 1	21	144	12	537
San Onofre 2	18	85	10	455
South Texas 1 *	24	141	12	423

* Data from 1995; currently in process of re-categorizing per ASME OMN-3 Code Case

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COST OF DEVELOPING AN RI-IST PROGRAM

The cost of developing an RI-IST program can be divided into several segments. First the IST components for which the RI-IST program is being applied need to be risk ranked with the Level 1 PRA (and Level 2 PRA if available). The six sensitivity studies identified in the ASME OMN-3 Code Case need to be performed. Available PRA software implemented at most plants make this task easy and straightforward. Then a worksheet for each component is developed, with input from the IST Basis Document and effect of other plant programs (such as the Preventive Maintenance program and Maintenance Rule program). An expert panel needs to be constituted to make the HSSC/LSSC decision, but in most plants there is already a Maintenance Rule expert panel in place which can be used for the final risk categorization.

Thus with the PRA and expert panel already in place, the incremental cost to support the development of a RI-IST program from these two organizational entities is relatively low (perhaps on the order of 40 person-hours for the PRA group and 240 person-hours for the expert panel). Since each IST component is evaluated by the expert panel for the HSSC/LSSC decision, to make that integrated decision-making process efficient a worksheet is prepared for each component. Preparing this worksheet typically requires half-hour per component. With 600 components, this effort would take about 300 person-hours, which represents the deterministic input for the expert panel.

After the expert panel has performed their categorization, a testing strategy is devised. For these 600 components, assume about ten minutes per component, including the identification of the testing method and testing interval (including appropriate grouping). Then those proposed testing strategies are inputted into the PRA to determine if the plant aggregate risk is satisfactory. So, assume 20 person-hours of effort from the PRA group is needed for this task. Currently a NRC licensing submittal is prepared, submitted to the NRC, and RAIs answered. NRC approval of the RI-IST program comes in the form of a SER. Typically about 500 man-hours are expended for this licensing effort.

To date the NRC has expended substantial person-hours on the review of the licensing submittal. Although these person-hours were not charged to Comanche Peak as a NRC pilot project, the charges for the San Onofre review were approximately 500 person-hours. Since the NRC would like to have most or all plants utilizing RI-IST programs, clearly they do not have the staff (or contractor funding) to perform reviews at the level of Comanche Peak or San Onofre. Thus the NRC is exploring the concept of advanced approval…for example if the RI-IST program is developed in accordance with the requirements of the ASME OMN-3 Code Case.

Finally the cost of revising the IST program implementing SPs is not trivial. A good assumption is the amount expended in the past for implementing a ten-year IST program update (see Table 4-1).

When all the above cost elements are added together (using $50 per plant man-hour), the minimum cost for implementing a RI-IST program is approximately $100,000.

Table 4-1
Comparison of Costs to Perform Ten Year IST Program Update

Plant	Internal/Program man-hrs	External/Program $	Internal/SP man-hrs	External/SP $
Palo Verde 1/2/3	4000	$35,000	2000	none
ANO-2	3000	none	2000	none
Calvert Cliffs 1/2	1000	$57,500	2000	none
WNP-2	2000	none	1000	none
Callaway	100	none	200	none

Benefits of an RI-IST Program

There are several potential benefits of an RI-IST program. One benefit is less surveillance testing performed per refueling cycle. Another benefit is less critical path surveillance testing during the refueling outage. Yet another benefit is less person-rem of radiation exposure during the refueling cycle. Finally, synergy can be achieved between IST, Technical Specifications, and other pump and valve component reliability programs. To achieve these benefits, plant management must be behind the RI-IST program initiative.

The benefit that is usually most quantifiable is the potential reduced cost of the program itself. This cost reduction is highly plant specific and dependent on the surveillance procedure accounting used at the plant. Typically the SIT SP and CV backflow SPs take a lot of set-up time. A working assumption is that a cost reduction of about 50% will result for each LSSC pump and valve, and that no cost reduction will result for HSSC pumps and valves. Balanced against these projected cost savings is the cost of developing and implementing a RI-IST program. Developing costs are largely determined by the availability of PRA data, the availability of the plant staff to convene the expert panel, and availability of the plant staff to prepare the RI-IST program, submit the program to the NRC, answer the RAIs, and finally to revise the plant implementing procedures.

For Comanche Peak, the number of IST SPs performed during the refueling cycle is being reduced from 1758 tests to 498 tests. For San Onofre, the number of IST SPs performed during the refueling cycle is being reduced from 8524 to 4516. Also for San Onofre, due to less IST implementing SPs they expect to save 10,000 person-hours per year and $50,000 per refueling cycle.

Since every plant is under generation production cost competitive pressure, shortening the periodic refueling outage to less than 30 days (and extending the refueling cycle to 24 months) has become the normal plant management goal. Since many IST SPs cannot be performed while on-line, these procedures have been placed into the refueling outage schedule. Occasionally they become critical path controlling events, with the resultant cost drivers of up to and over a million dollars per day for lost generation time. As plants start to actually achieve short outages, IST SPs will more and more frequently end up on the ‘critical path’. For San Onofre, 36 hours of critical path time during the refueling outage is expected to be saved. During a 30-day mid-cycle outage, San Onofre expects to complete 100% of the cold shutdown tests with one test crew. At Calvert Cliffs, their SPs for testing the large flow AFW pumps and for dumping the SITs are critical path or close to critical path.

RI-IST and Reduced Radiation Exposure

Over the past decade every nuclear plant has made substantial improvement in the number of person-rem of radiation exposure during the operating cycle. However, some plants accumulate appreciable radiation exposure performing IST. The SPs that create the most person-rem of radiation exposure are the CV inspections, especially those inside the containment (visualize just the insulation removal and bolting removal and reinstallation). Leakage rate testing for CIVs and PIVs are a substantial source of person-rem exposure. Calvert Cliffs estimated that if they were to convert to a RI-IST program, they would save one person-rem for each Safety Injection Tank MOV/CV not stroked. During each refueling outage they would save four person-rems.

Relationship of RI-IST and Other Programs

Over the years several layers of component reliability programs have been added in response to NRC generic letters, INPO SOERs, RCM analysis, JOG projects, and the Maintenance Rule. Frequently these various programs are all managed separately with overlapping requirements and no credit taken for the other related programs. For example NRC Generic Letter 96-05 requires periodic testing to demonstrate continued operational readiness of the MOV to respond to its design functions. The current IST requirements in the ASME OM Code require periodic stroke timing to determine operational readiness. The ASME developed the OMN-1 Code Case to allow some merger in these two programs, but to date only four plants are taking advantage of this synergy (and this code case is already approved by the NRC in Generic Letter 96-05). Another example is the INPO SOER 86-03 for CV reliability versus Appendix II to the ASME OM Code for CV operational readiness. Yet another example is the comprehensive Predictive Maintenance program

There are other, less easily quantified, benefits of a RI-IST program. These include fewer test induced failures of components, greater plant awareness of risk, an emphasis/attention on the plant components that have the greatest safety significance, and a better NRC/licensee understanding of the goals of the IST program. Since SPs typically involve operations, maintenance, and technical staff, coordinating across these three organizations can be a very time-consuming task.

Achieving Top Quartile Operating Performance

A “proactive” operating nuclear power plant has learned that good safety practices and good economic practices are synergistic with each other, especially in the active component arena. Chances are this “proactive” plant has a well-trained operating crew that understands the system impact on plant risk, hence they have train outages and yet allow some on-line maintenance. Chances are this “proactive” plant has some integration of its design basis, licensing basis, and

PRA basis (e.g., the risk significant portion). Chances are this “proactive” plant has a well thought out maintenance program, based on risk and performance (RCM is a good start for performance). Note that in reality IST is merely a subset of a good preventive maintenance program, but due to historical reasons it is subsumed into the Technical Specifications.

Future RI-IST Programs

The NRC has a major follow-on risk initiative in progress to further “refine” various plant programs, including IST. SECY 98-300 describes three alternatives, which the NRC Commissioners have asked the NRC Staff to pursue.

<u>Alternative #1 – Make No Change to Current Part 50</u>

This is generally considered to be the current “mature” RI-applications, such as the RI-IST program described by NRC Regulatory Guide 1.175 and the ASME OMN-3 Code Case.

<u>Alternative #2 – Make Changes to the Scope of Systems, Structures, and Components Covered by Those Sections of Part 50 Requiring Special Treatment</u>

“RISC-2” SSCs HSSC non-safety related	“RISC-1” SSCs HSSC safety related
Out of Scope SSCs LSSC non-safety related	“RISC-3” SSCs LSSC safety related

The scope of components within the safety related program would be identified by a RI-integrated decision-making methodology (instead of the current ASME Code Class 1/2/3 scope for IST).

<u>Alternative #3 – Make Changes to Specific Regulatory Requirements Within Part 50</u>

Changes would be made to the body of the Part 50 regulations to include risk-informed attributes in the requirements.

- Task 1: Identification of Candidate Requirements and Design Basis Accidents to be Revised
- Task 2: Prioritization of Candidate Requirements and Design Basis Accidents to be Revised
- Task 3: Identification of Proposed Changes

The technical requirements for RISC-1/2/3 would be developed for IST, as well as other application areas.

Since these follow-on risk initiatives were only announced by the NRC in late 1998, there is a many unknowns in this new initiative that may take many years to become approved within the current regulatory framework. However several aspects of such a RI-IST program can be reasonably extrapolated based on past experience:

1. the long-term reliance of the NRC on the ASME requirements for IST is likely to be preserved. That is, the NRC is likely to continue endorsing a specific ASME OM Code edition/addenda as “the” required IST requirements for implementing 10 CFR 50.55a.

2. the current RI-IST methodology/process (PRA and expert panel) of categorizing pumps and valves into HSSC and LSSC categories is likely to be utilized, especially since this general process is widely used in other RI-applications. A well-known graphical depiction of the risk significance of PRA modeled components is the below “quadrant chart”, which first appeared in ASME CRTD Vol. 40-2.

QUAD B –	F-V < 0.001 RAW > 2	QUAD C –	F-V > 0.001 RAW > 2
QUAD A –	F-V < 0.001 RAW < 2	QUAD D –	F-V > 0.001 RAW < 2

3. the latest ASME testing strategies for the HSSC category is likely to be applied along with some sort of coupling of the Preventive Maintenance program and the Maintenance Rule (performance monitoring) program for the LSSC category.

Based on the assumed aspects, described above, the front-end costs for a RI-IST program (PRA and expert panel) would probably remain the same, but the back-end costs (the implementing SPs for LSSC) could be drastically reduced. Even if the same LSSC testing strategies were imposed (and that is unlikely), having these “hidden failure” tests performed as preventive maintenance vice SPs would be a substantial improvement in plant economics with minimal impact on safety.

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CONCLUSIONS

One reason why there are only two plants (Comanche Peak 1/2 and San Onofre 2/3) with NRC approved RI-IST programs is that most plants are still working on the number one, two, and three initiatives discussed above. Clearly a base-loaded plant generating electricity 85% to 95% of the time is the primary goal of plant management. When that goal is achieved, then efficiently integrating plant “programs” is the effective way to achieve staff reduction…a major factor in reducing operating costs.

An integrated, risk-informed, and performance-based active component reliability program is the way to achieve further operating economics while maintaining safety. Since IST is a Tech Specs mandated program for nuclear safety defense-in-depth and safety margin, converting this program to RI-IST and PB-IST while integrating with the other plant component reliability programs is a great way to achieve further improvement in plant operating costs.

If a plant maintains their PRA up to date, then development and implementation of a RI-IST program is definitely an improvement in plant safety, since the IST efforts would be focused on the important pumps and valves and less radiation exposure would be accumulated by the surveillance testing crews. The RI-IST program can be an improvement in plant economics, depending on manpower needed for a specific test, how often the test is performed, amount of radiation dose incurred to perform the test, and whether the test is on (or near) the critical path for the outage. If a plant wants to get started with RI-IST for just one component group (such as AOVs with the current regulatory attention on AOV reliability…the approach being utilized at Davis-Besse), the real costs for developing and implementing a RI-IST program in a plant-specific environment can be measured.

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